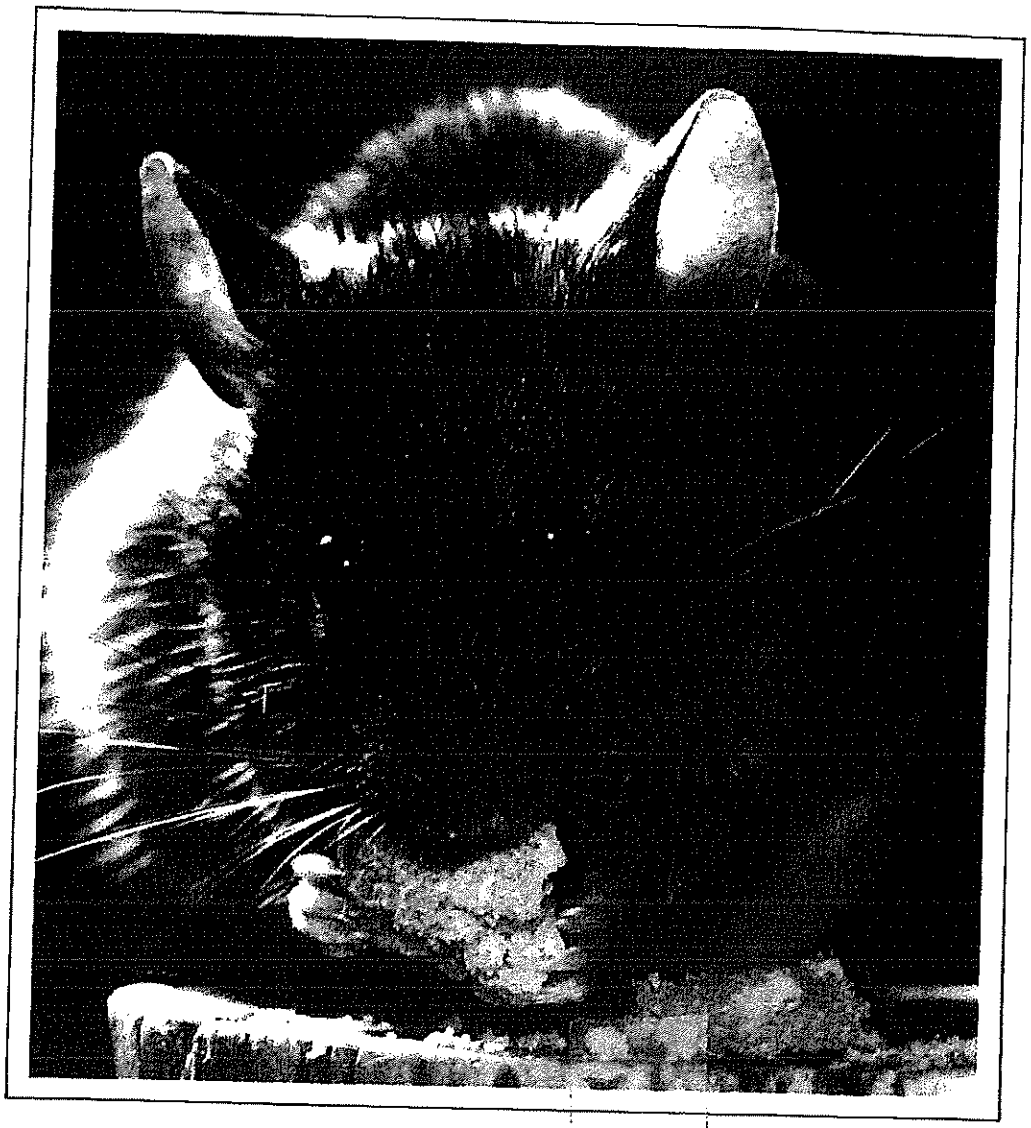
RATS and MICE

Their biology and control

A.P. Meehan



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There are a few situations where it is difficult, if not impossible, to control rats and mice with conventional rodenticides. These often occur where there is a danger of accidentally poisoning non-target species. In addition there are a number of countries in the world where strong environmental lobbies are against the use of any chemical pesticides, including rodenticides. There must be a possibility that one day in the future, some governments will bow to this lobby, however irrational their fears, and ban chemical pesticides – at least in some situations. Consequently there is a need, both now and in the future, for methods of rat and mouse control which do not use toxicants, should a ban on rodenticides occur.

Some methods of controlling rodents without toxicants have been used for centuries. Trapping, for instance, can be very successful when carried out correctly. However, some of the more modern methods such as the use of ultrasound, electromagnetic waves, attractants, repellents and chemosterilants have been less successful. The advantages, disadvantages and efficiency of these methods will be discussed in this chapter. Information on how and when to use some of the methods is given in Chapter 13.

ULTRASONICS

Ultrasonic sound is generally taken to be any sound above the limit of hearing in man, which is at a frequency of about 20kHz. There is little doubt that ultrasonic noises produced by rats and mice influence their behaviour; for example, the rate of copulation by female rats is increased after priming with male ultrasonic vocalisations.[438] Female mice build a heavier nest when subjected to the ultrasonic calls of cold infants[768] and ultrasonic noise emitted by pups can also help female rats locate their young.[10] Even the pups of deaf mice produce ultrasounds.[1094] (See p. 59.)

Adverse effects of high intensity sound on rodents have been reported many times. Auditory stress can lead to marked changes in the endocrine systems of rats and mice. For instance, repeated exposure for two seconds to a frequency of 20kHz at 98–100 decibels causes diuresis in rats[774] and cardiac hypertrophy may occur in rats exposed to other auditory stresses.[434]

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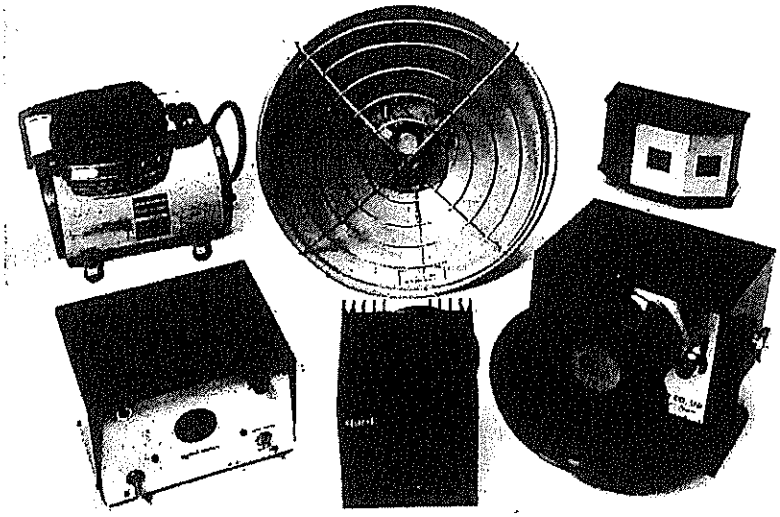

Fig. 96. Ultrasonic devices are manufactured in a variety of forms.

Busnell[635] have reviewed this subject extensively, but rats are relatively resistant to these. Intense ultrasonics can injure or kill rodents[424] and mice exposed to 20kHz at 160db die of overheating within one minute.[9]

It is on the basis of these and other adverse effects that ultrasonics have been promoted as a means of rat and mouse control. Many manufacturers are making extravagant claims that devices producing ultrasonics (Fig. 96) will kill, or disrupt the behaviour of rats and mice, thus clearing buildings of an infestation. *There is no scientific evidence that these claims are correct.* Howard[533] states "Eight years of our evaluation of basic principles inherent to the use of acoustical frightening devices produced only negative results". Similar negative results have also been achieved in tests conducted at Texas A.& M. University[1167] and at the Danish Pest Infestation Laboratory.[1240] In fact, the Environmental Protection Agency in the U.S.A. has warned some distributors of ultrasonic equipment that their misleading advertising may be illegal.[1168]

Frings[423] appears to have been the first to recommend sound as a rodent deterrent but he carried out no practical tests. In fact, relatively few evaluations of these devices have been made. Some tests have been described in which a frequency of 15–16kHz (within the audible range) failed to deter rats from selected areas in three grain elevators.[696] Higher frequencies also failed to "repel rats and mice from any of the tested areas"[1014] and it has been determined that ultrasonic sound is unlikely to keep brown rats from food.[629, 729] Strategically placed devices may

prevent or reduce entry to a building but they will not disperse established infestations.[334, 468]

To date, Rentokil has tested about 20 different devices against brown rats and a lesser number against black rats and mice in indoor and outdoor experimental situations as well as in practical field trials. None of the units produced anything more than a partial repellency for a day or so which was soon overcome, regardless of whether the frequency was variable, random and/or intermittent. Some produced no noticeable effect.[879] Results with a typical device against *R. rattus* are outlined in Figure 97. However, some machines apparently reduce the food intake of this same species but availability of food and other factors influenced the effect.[978]

There are two major reasons why the author considers ultrasonic noise fails to significantly disrupt rat or mouse behaviour. Firstly, ultrasound does not penetrate solid objects; it is readily absorbed by many surfaces. Thus rodents in harbourages, burrows and in stacked goods remain unaffected in 'sound shadows'. The only possible way to overcome sound shadows would be to use many units at extremely high cost – but the effect would probably not be improved sufficiently to warrant such expenditure. Secondly, ultrasound rapidly attenuates (i.e. does not travel far) in air[317] so high energy sources of sound are required. This

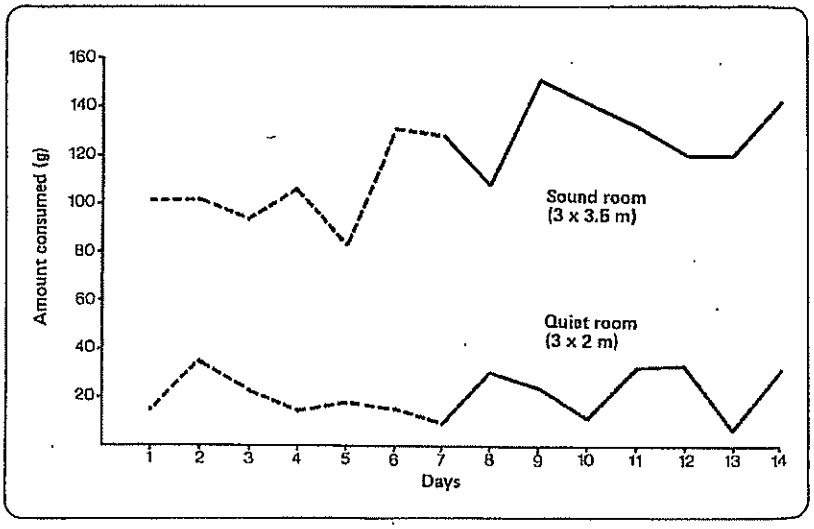

Fig. 97. Daily food consumption of 15 *Rattus rattus* in two connected rooms, both containing excess food, water and harbourage. One room (sound room) also contained an ultrasonic device which was switched on after seven days. It is obvious that instead of food consumption decreasing in the sound room it has actually increased. (Meehan.[727])

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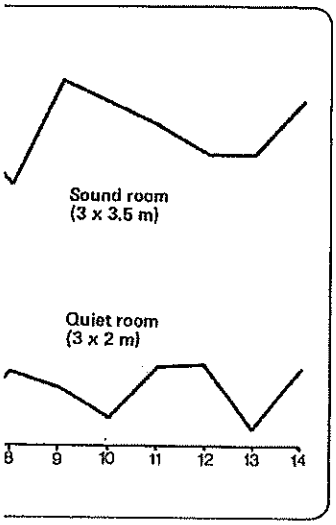

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shortcoming could perhaps be resolved with the development of a high intensity corona type loudspeaker[825] but details of tests with a device of this type are not available to the author. In addition the habituation of rats and mice to the sound will not be easily overcome.

Despite the failure of current ultrasonic machines, there is a possibility that a successful device will eventually be produced. Perhaps when more is known about the 'ultrasonic language' of rats and mice a unit could be devised using sounds associated with certain activities of the animal and tailored to the receptors and psychology of individual species. Even then biological variation will inevitably result in a number of non-responders. There has also been a suggestion that ultrasonics may prove to be more useful as an attractant rather than a deterrent.[71]

ELECTROMAGNETICS

As an extension of the use of ultrasonic machines, units claimed to produce 'electromagnetic' waves which disrupt pest behaviour have also been suggested for rat and mouse control.

As with ultrasonic devices, there are many extravagant claims by the producers of electromagnetic devices for their efficiency at controlling rats and mice. Affected animals either leave the electromagnetic field or become so disturbed that they cease feeding and reproducing. Some of the devices are supposed to be harmful to *all* pest animals from termites to rodents but harmless to man, domestic and other beneficial animals! One manufacturer (Orgolini Manufacturing Company) states that this is because the higher sodium content of wild animals makes them more susceptible![784]

Undoubtedly electric and magnetic fields do disturb the physiology of animals. For instance, the concentration of pyruvic and lactic acid in the blood of rats exposed to magnetic fields is lowered[509] and rats exposed to strong electric fields show changes in serum proteins and rate of body weight gain.[689] Electric fields also affect the activity of rats.[522] Kaufman and Michaelson,[588] who have extensively reviewed the subject of magnetic fields on animals, conclude that a wide range of physiological effects can be identified, but they differ from laboratory to laboratory and are difficult to interpret.

However, scientifically conducted tests with commercially available electromagnetic devices have failed to produce any gross change in the behaviour of rats or mice despite some testimonials from "satisfied customers" who claim they have been at least partially successful. Examination of some machines has failed to detect any measurable magnetic output, whilst others produce no more than an electric soldering iron![1097] Fitzwater[411] has reviewed most of the available information on these machines and concludes there is little objective support for their use in pest control.

Tests against wild *R. norvegicus* in Rentokil's large outdoor pen (Fig.

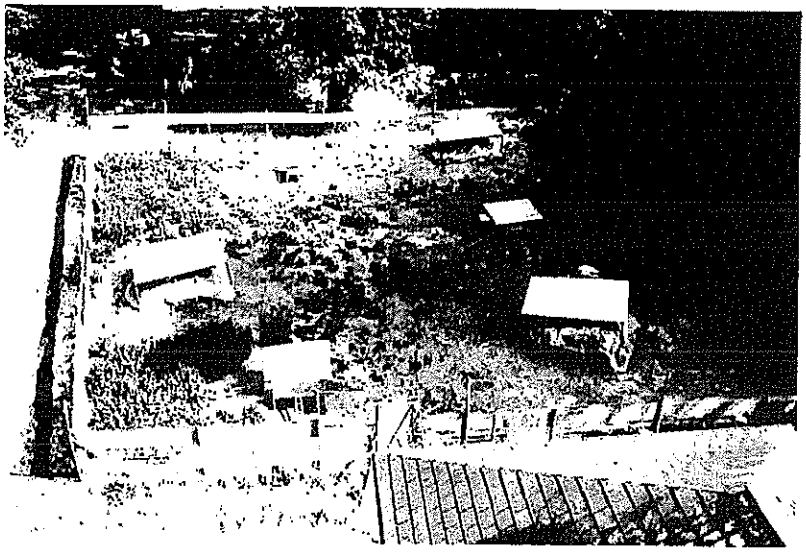


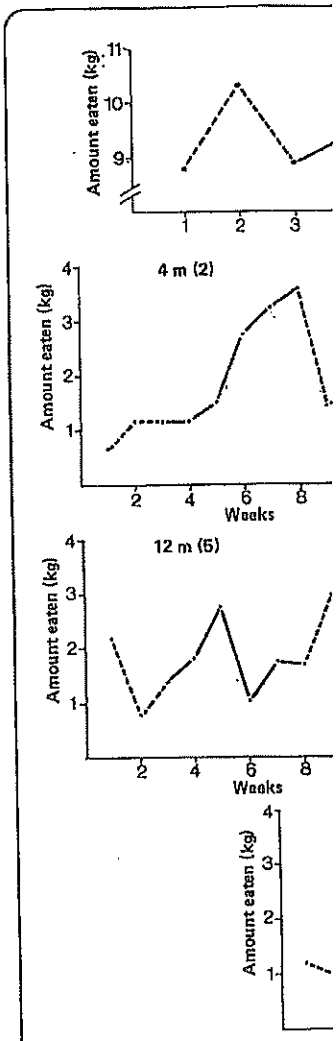
Fig. 98. Rentokil's outdoor brown rat pen in which the evaluation of ultrasonic and electromagnetic devices has been conducted.

98) showed similar results.[174] There was no evidence of a shift in the number or distribution of open rodent burrows across the pen; even those close to the device remained in use. A litter of rats, which must have been conceived after the machine was in operation was also found close by. Total food consumption remained fairly steady throughout the test period (Fig. 99). At feeding points furthest from the device (20m) there was an increase in food consumption. However, this cannot be considered evidence for its effectiveness because at the points nearest the machine (4m) there was also an increase.

Similar machines have proved ineffective against house mice,[246] pine voles[233] and pocket gophers.[244]

The Environmental Protection Agency of the U.S. government have tested some machines and agree they are not effective; they have banned the sale of several.[70, 77] Unfortunately the E.P.A. is no longer able to carry out efficacy testing[88] and prospective users will have to conduct their own tests.

Perhaps in the future a machine based on a physical property will succeed in controlling rats and mice, but in the meantime it should be stressed there is no such thing as 'push button' rodent control.



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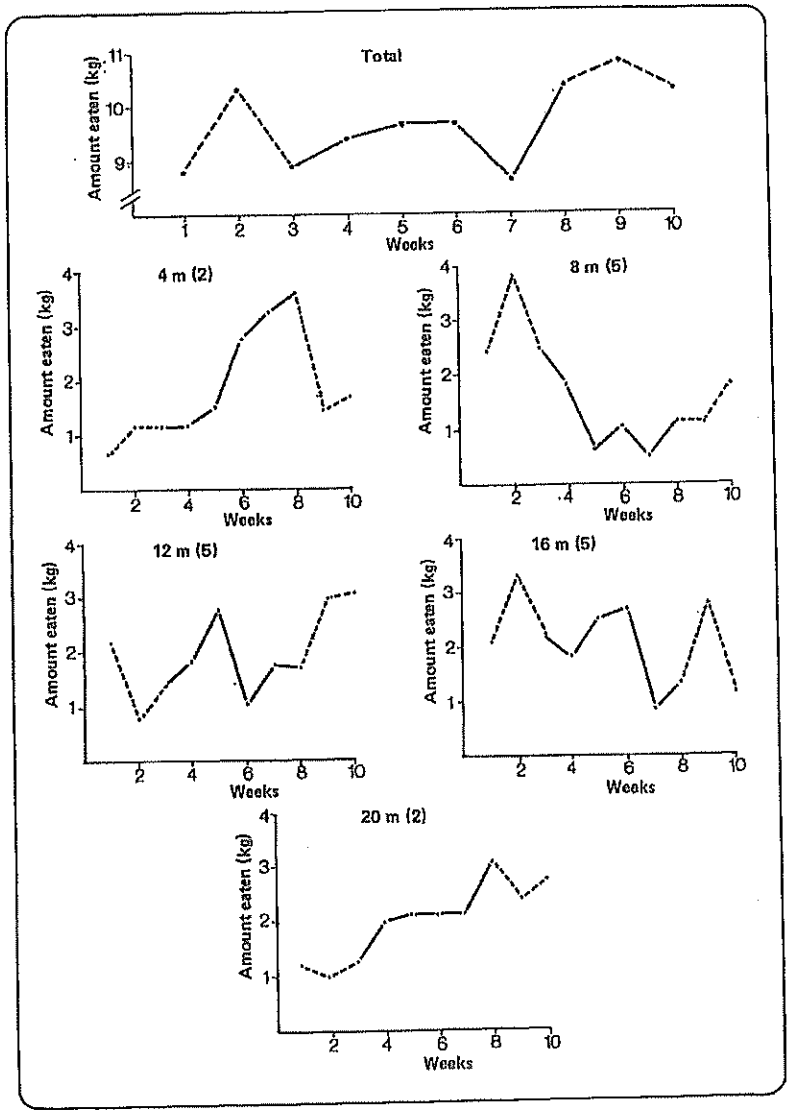

Fig. 99. The top graph shows the total weekly food consumption from a test pen (17 × 17m) containing wild *R. norvegicus* exposed to an electromagnetic device. The device was functioning from the beginning of week three to the end of week eight (solid line). The smaller graphs show food consumption at feeding points positioned at various distances from the device. The numbers in brackets indicate number of feeding points. (After Bohills, Leonard & Meehan.[174])